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EDITORIAL DEPARTMENT NOTE

The two industries dealt with in the articles in this issue of the *Bulletin*, flour milling and cement, are representative of the process type of manufacturing. Yet the accounting methods described in these two articles are very dissimilar. The flour milling industry has the problem of quoting prices for future delivery on a product manufactured from a raw material whose price varies constantly. Consequently, a daily control of the relation of raw material cost to sales prices and the use of normal conversion costs based on budgets have been among the accountant's most important contributions to this industry. In the manufacture of cement, raw material costs and selling prices fluctuate very little, and the problem of costing is relatively simple and generally representative of the process type of industry, but the problem of accounting for returnable containers and freight present somewhat unusual features.

The author of our first article is Robert R. McCreight, who was born in Southern Ohio and received his college education at the State Teachers College at Athens, Ohio. After teaching in Ohio and Oklahoma for five years, he left the teaching profession to take a position with the Cudahy Packing Co. in Wichita, Kansas. Later he was employed by the Kansas Milling Co. of Wichita, where he gained his first experience in the flour milling industry. In 1919, Mr. McCreight moved to Kansas City to become Auditor for the Larabee Flour Mills, but two years later became associated with the Midland Flour Co., where he is at present serving as Assistant Treasurer. Mr. McCreight is a member of our Kansas City Chapter.

Leon E. Smith, the author of our second paper, has been engaged in the practice of public accounting since 1932 as a staff member of the Dallas office of Lybrand, Ross Bros. & Montgomery. Prior to 1932 he was employed in the general accounting departments of several nationally known companies engaged in baking, oil production, lumber, and cement manufacturing and public utilities. Mr. Smith is a C.P.A. of Texas and Louisiana, and a member of the Texas Society of C.P.A.'s and the American Institute of Accountants.

Articles published in the *Bulletin* present many different viewpoints. In publishing them the Association is not sponsoring the views expressed, but is endeavoring to provide for its members material which will be helpful and stimulating. Constructive comments are welcomed and will be published in the Forum Section of the *Bulletin*.

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COST ACCOUNTANTS

OCTOBER 1, 1941

FLOUR MILLING COSTS

By Robert R. McCreight, Assistant Treasurer,
Midland Flour Milling Co., Kansas City, Mo.

OUR OPERATIONS are segregated into three main departments, namely, milling department, grain department, and country grain buying stations. The operations of a flour mill consist mainly of converting wheat into flour. In connection with the milling operations we obtain certain by-products known as low grade flour and offal. All transactions relating to the milling of flour and the sale of flour and offal are included in the milling department.

One of the important factors in the operations of a flour mill is the avoidance, so far as possible, of the speculative element which ordinarily follows the ownership of grain. Since most flour is sold for delivery within a period of 60 to 120 days, the company must protect itself against market losses on future deliveries of flour by purchasing "cash" grain at the time such sales are made or by "hedging" with grain futures. All transactions relating to the purchase or sale of grain and "futures" are included in the operations of the grain department.

Gross Recovery Over Material Costs

Since the profit from the milling operations really represents the profit on the conversion of wheat to flour, we are vitally interested in the gross recovery over the material cost of the flour shipped and so arrange our accounting that this information is furnished by grades of flour shipped.

The gross recovery over material cost is calculated on each sales contract at the time the booking of the sale is made. The computation is made on the basis of the market price of wheat and the market value of clear and low grade flour and offal on the date the sales contract is consummated. An example of the method used in computing the gross recovery value and the form designed for this purpose are as shown at the top of page 152.

Sales Price				$5.00
Wheat		3.70		
Clears	.32			
Offal	.39	.71	2.99	
Package			.20	
Ingredients				
Freight			.85	3.95
Gross Recovery				$1.05

If the sales contract covers various grades of flour a separate form is prepared for each grade.

The above information is entered on the sales contract and is transferred to sales invoices covering shipments applying against such order in the following manner:

No. of Bbls.	*Sale Price*	*Wheat*	*Clear*	*Offal*	*Package*	*Ingredients*	*Freight*	*Gross Recovery*

The amounts to be inserted in the above spaces are taken from the entries on the sales contract, provided the shipments are in exact conformity with the basis on which the order was booked. The values inserted must be on a barrel basis, as each item of flour on the invoice must be extended at the values shown to get the total value of the shipment.

The various factors inserted on the sales invoices, as shown above, are accumulated daily by means of the punch card system. This accumulation is made by grades of flour, thus enabling us to secure for each month the various elements of material cost and the gross recovery value over material cost, on all flour shipped during any given period. This information is also accumulated each month until the end of our fiscal year. Totaling the gross recovery on all grades of flour shipped gives us the total gross recovery for the month, which is the first item on our monthly profit and loss statement.

Cost Cards

In order to prepare the gross recovery forms, it is necessary to prepare cost cards on the various grades of flour. These cost cards

are prepared daily for each grade of flour and are based on the market price of wheat and the market value of offal, clear and low grade flour.

The method of preparing cost cards for the various grades of flour may be illustrated by first assuming that—

(a)	Market value of wheat	$ .70 per bu.
(b)	Market value of offal—average run	11.00 per ton
(c)	Market value of first clear	2.20 per bbl.
(d)	Market value of second clear	1.70 per bbl.
(e)	4.5 bu. of grain mixture will produce one barrel of flour of all grades and 74 pounds of offal.	
(f)	Primary grades of flour:	100% straight grade 85% short patent grade 10% first clear 5% second clear
(g)	Average total expense per barrel is $1.00	

The customary method of computing the cost of 85 per cent short patent with the foregoing factors would be as follows:

4.5 bushels wheat at 70 cents		$3.15
Add expense (including selling expenses)		1.00
Total wheat expense		$4.15
Deduct feed at market:		
74 lbs. offal at $9.00 ($11.00—$2.00 discount)		.333
Cost of barrel of 100 per cent (straight) flour		$3.817
Deduct clears at market:		
10% first clear at $2.00	$ .20	
5% second clear at $1.50	.075	.275
85% of a barrel of short patent		$3.542

The value of clears has been discounted 20 cents per barrel in computing cost of patents.

If 85 per cent of a barrel of short patent flour costs $3.542, the cost of producing a full barrel of 85 per cent short patent flour can be arrived at by dividing the $3.542 by 85 per cent, which produces a total cost of $4.167 for a full barrel of 85 per cent patent.

A cost card is then prepared which enables us to get an analysis of the items entering into the material cost of a barrel of flour.

COST CARD

	Pounds	*Market Price, Less Discount*	*Price*	*Amount*
5.294 bu. wheat	317.64		$0.70 bu.	$3.7058
Deduct low grades and offal:				
10% first clear	23.05	$2.00 bbl.	1.02 cwt.	.2351
5% second clear	11.52	1.50 bbl.	.7653 "	.0882
27.41% offal	87.07	9.00 ton	.45 "	.3918
Total deductions	121.64			.7151
1 barrel of short patent, 196 lbs.				$2.9907
Expense per barrel ($1.00 divided by 85)				1.1764
Cost of barrel of 85% flour				$4.1671

The above computation shows the cost of the wheat to be $3.7058, the value of the clear allowance $0.3233, the value of the offal allowance $0.3918, and the net cost of a barrel of 85 per cent flour to be $4.1671. Similar formulae were devised for other primary grades of flour.

Cost of Secondary Grades

Secondary grades of flour are those made of a combination of parts from primary grades.

Having ascertained which of the primary grades are to be used, and the percentage of each required to make the secondary grade, the cost of the secondary grade is computed by merely applying the percentages of the primary grades to the cost of the respective grades and totaling the result. As an illustration let us assume that Grade C is to be made from 80 per cent Grade A (100 per cent straight) and 20 per cent Grade X (first clear). Also assume that the material cost of Grade A is $2.82 bulk and the market value of Grade X is $2.20 bulk at the mill. The computation for the C grade would be as follows:

80% of $2.817 equals	$2.2536
20% of $2.20 equals	.4400
Total	$2.6936—the material cost of one barrel of Grade "C" flour.

In order to get our desired information relative to the value of wheat, clear, and offal in our cost, we applied the percentage of the quantities as follows:

80% of 4.5 bushels equals	3.6 bu.	wheat at	$ .70 bu.....	$2.52
Plus 20% of Grade X equals	39.2 lbs.	wheat at	2.20 bbl.....	.44
Total				$2.9600
Less 80% of 74# offal equals	59.2 lbs.	wheat at	.45 cwt.....	.2664
Material cost of one barrel of Grade C flour				$2.6936

Budgetary Control

Our budget covers the expense allowance for conversion costs at a selected normal operating level. It does not, as in most cases, include a forecast of sales, as selling prices are relatively unimportant. We are primarily concerned with the gross recovery over the material cost of flour and the final net profit on conversion.

Our master expense budget is prepared for a twelve-months period and is broken down by months. It furnishes us, among other things, with a breakdown of expenses, a comparison of actual with budgeted expenses, an analysis of the over- or under-absorbed expenses and the reason for such differences—whether due to excessive expenditures or to production levels. The budget has enabled us to establish normal costs for expenses which are used in quoting selling prices of flour and permits the establishment of cost of production, cost of sales and inventory values.

In order that the budget may serve as an aid to administrative control it is essential that a careful scrutiny of expenses be made to determine the expenses which are fixed or constant and those which vary with the level of milling operations.

We have developed several monthly charts in connection with manufacturing costs. The two included here are fairly representative of the type of information submitted monthly to the management.

Exhibit 1—Manufacturing Expenses

This chart was designed to provide a comparison of the actual manufacturing expenses with the master budget. It proyides also a summary of the expenses absorbed during the month at budget rates. The over- or under-absorbed manufacturing expenses for the month are also set out on this chart. There is a further analysis, showing whether over- or under-expenditures, or variation

EXHIBIT 1

MANUFACTURING EXPENSES	Master Monthly Budget	Actual Expenses Incurred	Expense Absorbed at Budget Rates	Over or (Under) Absorbed	Analysis of Over or (Under) Absorbed Expense: Due to Expenditure	Analysis of Over or (Under) Absorbed Expense: Due to Operating Level	Cost per Barrel: Budget	Cost per Barrel: Actual
Depreciation	$ 3,050	$3,050	$3,740	$ 690	—	$ 690	.044	.036
Taxes	3,810	3,810	4,590	780	—	780	.055	.045
Insurance	3,010	3,010	3,655	645	—	645	.043	.035
Power Purchased	3,520	4,030	4,250	220	(510)	730	.050	.047
Elevator Labor	1,460	1,570	1,785	215	(110)	325	.021	.018
Mill Labor	1,600	1,800	1,955	155	(200)	355	.023	.021
Maintenance Labor	730	680	850	170	50	120	.010	.008
Packing Labor	2,100	2,510	2,550	40	(410)	450	.030	.030
Loading Labor	2,400	2,600	2,890	290	(200)	490	.034	.031
Supervision	1,560	1,560	1,870	310	—	310	.022	.018
Supplies	400	500	510	10	(100)	110	.006	.006
Material for repairs	850	870	1,020	150	(20)	170	.012	.010
Bleaching	1,700	1,620	2,040	420	80	340	.024	.019
Miscellaneous	810	890	1,020	130	(80)	210	.012	.011
	$27,000	$28,500	$32,725	$4,225	(1,500)	$5,725	.386	.335

Budgeted production 70,000 bbls. (representing 70% of capacity of 100,000 bbls.)

Actual production 85,000 bbls.

Operating Ratios:

Production to Capacity	85 %
Production to Budget	121.4%
Expense to Budget	105.6%

( ) denotes red figures.

Expense to Budget..... 105.6%

( ) denotes red figures.

EXHIBIT 2.

	Master Budget		*Variable Budget at Operating Level Obtained*	Actual Expense		*Actual Expense (Over) or Under Budget at Attained Operating Level*	
	Constant	*Variable per Bbl.*		*Constant*	*Variable*	*Constant*	*Variable*
Depreciation	$3,050	—	—	$3,050	—	—	—
Taxes	3,810	—	—	3,810	—	—	—
Insurance	3,010	—	—	3,010	—	—	—
Power Purchased	2,600	.013	$1,105	2,600	$1,430	—	(325)
Elevator Labor	920	.008	680	920	650	—	30
Mill Labor	1,240	.005	425	1,240	560	—	(135)
Maintenance Labor	560	.002	170	500	180	60	(10)
Packing Labor	—	.030	2,550	—	2,510	—	40
Loading Labor	600	.026	2,210	600	2,000	—	210
Supervision	1,560	—	—	1,560	—	—	—
Supplies	260	.002	170	260	240	—	(70)
Materials for Repairs	780	.001	85	780	90	—	(5)
Bleaching	—	.024	2,040	—	1,620	—	420
Miscellaneous	700	.002	170	700	190	—	(20)
	$19,090	.113	$9,605	$19,030	$9,470	60	135

( ) Denotes red figures.

in the operating level was responsible for the amount over- or under-absorbed.

The total manufacturing expenses absorbed at budget rates as shown in the third money column of Exhibit 1 is debited to "Manufacturing Expense Applicable to Shipments" in the general ledger, and a corresponding credit is made to expense ledger account "Manufacturing Expense Absorbed." Since the charges to the "Manufacturing Expense Absorbed" account are based on production, at budget rates, the account must be adjusted to give effect to the increase or decrease in the amount of expenses included in valuing the inventories at the beginning and end of each period. The manufacturing expense absorbed as adjusted is shown in the profit and loss statement (see page 159) as a deduction from the gross recovery figure. Administrative and selling expenses are also absorbed on a budgeted basis and a comparison of actual with the budget is made monthly. The over- or under-absorbed expense is considered a general profit and loss item and is entered on the profit and loss statement as "Variation of Expense."

Exhibit 2—Master Budget

This chart is prepared to show the segregation of constant and variable expenses and to provide a comparison of budgeted expense with actual expenses for the month. It should be noted that the budgeted variable expenses are shown on a per barrel basis. This is done to permit the extension of variable expenses at the operating level obtained during the month. We also show in this schedule our actual expenses divided as between constant and variable and the difference between the actual expense and the budget at volume attained for each division of expense.

The Profit and Loss Statement

A condensed monthly profit and loss statement is shown on page 159 as Exhibit 3. Having previously explained the method of accruing items 1 to 6 on the profit and loss statement, we shall omit a further discussion here, but will comment briefly on the remaining items included in the monthly mill department statement:

(8) Offal sales in excess of cost card value represents the difference between the sale price of the various grades of offal and

EXHIBIT 3.

PROFIT AND LOSS STATEMENT

Mill Department

Flour Shipments:

(1) Gross recovery over material costs.....

(2) Manufacturing expense absorbed at budget rates (adjusted by increase or decrease in inventory).....

(3) Gross recovery less budgeted manufacturing expense....
(4) Administration and office selling absorbed at budgeted rates .....

(5) Net profit or (loss) on flour at budgeted expense.....
(6) Variation of expense (over- or under-absorbed).....

(7) Net profit or (loss) on flour at actual expense.....

Other Items of Mill Department:

(8) Offal sales in excess of cost card values.....
(9) Realization of discount on offal sales.....
(10) Realization of discount on clear sales.....
(11) Temper gain .....
(12) Freight variance .....
(13) Package variance .....
(14) Ingredient variance .....

Realized profit or (loss).....

Unrealized profit or (loss)

(15) Loss or gain in clears to be produced from flour orders..
(16) Loss or gain in offal, to be produced from flour orders..
(17) Insufficient gross recovery in flour order.....

Total unrealized profit or (loss).....

Total profit or loss Mill Department.....
Grain Department .....
Country Grain Buying Stations.....

Net Gain for the Period.....

the cost card value on day of such offal sale. The procedure for arriving at this is comparable to that used to get the gross recovery over material costs on flour.

(9) This item, as its name indicates, should show whether the discount at which offal was priced for purpose of computing cost of flour, has or has not been realized. It is affected by the variance between the opening and closing inventory value of offal and by the rise or fall in offal values between the dates of booking the order and the actual milling date.

(10) This is much the same as the previous item, with the exception that it refers to clear grades of flour. It is also affected by the inventory and market fluctuations in value.

(11) Temper gain represents the increase in weight by the added moisture used to temper wheat to the condition best suitable for efficient milling. This can be an estimate until such time as wheat stocks are sufficiently low to permit an actual weigh-up in order to determine the actual gain. The profit and loss figure for each month is based upon laboratory estimates of the increase in percentage of moisture in the product as taken off the mill, over the moisture in the wheat received for milling.

(12) The difference between the amount of freight used in costing sales and that actually paid when shipment moves, produces the freight variance figure.

(13) The package variance arises from two sources: (a) the market advance or decline on bags in stocks or on bags bought on deferred delivery contracts, and (b), the package differential due to the various sizes of packages used for certain classes of trade.

In addition to the foregoing items, which represent actual realized profits or losses, there is another factor which must be considered when orders are booked with a gross recovery of less than the actual expense to make and ship the orders. There is also a fluctuation entering into the cost of material with which to fill the orders. These can all be brought out by an inventory of all unfilled orders at close of each accounting period.

Inventory of Unfilled Orders

A cost card based on the market at that date is prepared for each grade of flour remaining unshipped at the end of any accounting period. The cost of wheat, clear and offal shown by these cost cards is then applied to the total barrels of each grade of flour not shipped, to determine the market value of wheat required to produce the flour not shipped and the relative cost of clears and offal. The difference between the wheat values at time of booking and at inventory date appears as a part of the profit and loss of the grain department, while the difference between the values of clears and offal as at date of booking and at inventory date appear as items numbered 15 and 16 in the profit and loss statement.

(17) This item represents the amount by which the budget cost of producing and shipping the unfilled sales contracts exceeds the gross recovery over material cost as determined at date of sale. This results in charging the loss on orders taken at an insufficient gross recovery, to the month in which the sales contract was made.

This paper has been limited to a discussion of milling costs and profit and loss factors relating strictly to milling operations. Purchases and sales of grain and transactions relating to "hedging" have purposely been excluded from this paper as they are not directly connected with milling costs and warrant separate treatment and discussion. The cost and budget system briefly outlined in this paper has been in use for a number of years and has proven itself invaluable to the management.

ACCOUNTING IN THE CEMENT INDUSTRY

By Leon E. Smith, Staff,
Lybrand, Ross Bros. & Montgomery, Dallas, Texas

CONTRARY to the ideas of many people, portland cement is not the name of a brand of cement, but merely designates a type of cement. At the present time portland cement is frequently referred to merely as cement because it is so widely used. Portland cement can be produced and sold under any trade name. The name "sterling" on silver is a mark of purity and quality and in the same manner "portland," when used in connection with cement, indicates a standard which represents the attainment of a degree of quality which is fixed by an accepted standard. Portland cement when mixed with sand, stone and water forms concrete which is, in effect, "stone that can be molded."

Cement is usually made from limestone and clay, shale or blast furnace slag, and marl or clay. Oyster shells may be also used, as the main constituents of cement are lime, silica and alumina.

Portland cement manufacture is the art of taking definite proportions of such raw materials as are noted above, grinding them to extreme fineness, burning them at a temperature that would melt steel, and regrinding the resulting clinker to a powder finer than flour.

Cement manufacturing is a continuous process industry. The raw materials are caused to flow through the various manufacturing operations until the finished product emerges, ready for packing and loading for shipment by rail or truck.

Manufacturing Method

There are two methods of manufacturing cement, the dry process and the wet process. In the dry process plants, the raw materials are dried and the material kept in as dry a condition as possible through the entire process of grinding and mixing, while in the wet process plants, water is added to the raw materials. Otherwise the manufacturing operations are essentially the same.

In the following brief description of the manufacturing methods used in the cement industry, the product will be followed through the various steps of manufacture from the quarry to the packing house of the finished, sacked cement ready for shipment. For this

purpose, a wet process plant will be described using limestone and shale as the raw materials, the raw materials being secured by production from its own quarries, natural gas being used as fuel, and electric power being purchased rather than generated by the plant. Fuel for heating the kilns for clinker burning is not limited to natural gas, as either coal or crude oil may be used for this purpose. The type of fuel used depends upon the geographical location of the plant.

Quarrying

The limestone and shale used as raw materials is secured by production from quarries adjacent to the manufacturing plant. The first step in quarrying is to remove the top refuse material, and this operation is called "stripping." Stripping may be done in advance of the raw material requirements and the expense of advanced stripping deferred to subsequent accounting periods. In the case of shale (a soft material) electric shovels are used to load the shale into quarry cars for transportation over the plant railroad to the mill. In the case of limestone, this material is first broken up by charges of dynamite and the broken pieces of rock are loaded into quarry cars for transportation to the mill for crushing. Before the raw materials are removed from the quarry, chemical analyses are made to indicate the characteristics of the raw materials in the various parts of the quarry. The rock and shale are proportioned as the quarry cars are unloaded into the crusher at the mill under the supervision of the chemists in order to control the proper proportion of raw materials. Ordinarily, five cars of rock are used to one car of shale; however, this proportion will vary as the rock and shale change in chemical composition. An analysis of the above noted raw materials indicates the following approximate percentage of chemical elements:

	Rock	*Shale*
Silica	1.16%	60.20%
Alumina	.33	19.42
Ferric oxide	.08	8.24
Lime	54.82	.40
Magnesia	.28	1.46
Sulphuric anhydride	Trace	Trace
Carbonic anhydride	43.33	10.28
	100.00%	100.00%

Crushing

The initial crushing is performed in two stages. First, the quarry cars of raw materials are dumped in the huge hopper of the preliminary crusher as the rock varies in size from pieces as large as a man's head to boulders three feet in diameter. The crushing is done by a gyratory crusher in which the motion of a central jaw causes a crushing action against the outer jaw. This machine will handle 150 tons of material per hour. Second, the crushed stone is fed into a smaller crusher or hammer mill in which rods with hinged heads are allowed to swing around rapidly against stationary bars on the outer edge of the mill. Modern plants of an improved type have installed machinery to crush the stone in one operation.

Rock Storage

Bucket elevators carry the raw materials from the crushing mills to storage bins to form the first step in blending the two raw materials. One bin contains rock only and is used to regulate the composition of the mixture. Through spouts in the floor of the bins, the mixture of limestone and shale is drawn into scale cars located under the bins.

Raw Grinding

After the raw material is accurately weighed it is fed onto the belt conveyors from which it falls into bucket elevators. These buckets elevate the material to bins directly over the ball mills. It is at this point that the requisite amount of water is added to the raw materials by plants using the wet process method. Up to this point the operations of a dry process plant and a wet process plant have been the same. The ball mills are hollow revolving cylinders lined with steel plates, each cylinder containing approximately a 12,000 pound charge of steel balls, five inches or smaller in diameter. The rock and shale to which water has been added is fed into these machines and, by the steel balls revolving against the outer band of hardened steel, is reduced to a soupy mixture called "slurry." The slurry is then fed into tube mills, which are hollow steel cylinders operating on a different principle from the ball mills. The tube mills are steel tubes 5 feet in diameter and 22 feet long,

each containing 35,000 pounds of ⅞-inch iron slugs, which are about 1½ inches long. The tube mills reduce the slurry to a fineness greater than that of talcum powder—so fine that 90 per cent of it will pass through a 200 mesh sieve with 40,000 openings per square inch. At this stage of production every particle of the raw materials has been powdered, hammered and worked together so thoroughly that even an analysis scarcely would distinguish one particle from another.

Blending and Storage Tanks

The slurry is conveyed to large storage and blending basins which have a capacity of one to two thousand barrels of slurry each. To prevent settlement in the tanks, the slurry is kept in constant movement by revolving paddles. These agitators, are like giant egg beaters and mix and remix the slurry constantly. The tanks are connected with each other in such a way as to allow the contents of any blending tank to be conveyed to any other tank. From the mixers the slurry is pumped to a small tank at the top end of the kiln, whence it is fed into the kilns.

Burning

The most essential part of the manufacture of portland cement is the complete chemical combustion of the raw materials containing silica, lime and alumina. The kiln into which the slurry is fed consists of a cylindrical shell made of steel plates, lined with fire brick for nearly the whole of its length. The kilns are approximately 12 feet in diameter and 300 feet long, each kiln being connected to a separate 200-foot smoke stack. The enlarged diameter of the kiln is at the firing zone of the kilns and the kilns are set at an angle of 1 in 25 feet. The kiln in operation slowly revolves on tyres and is driven by a ring gear. The slurry is fed into the kilns at the elevated end and flows along the bottom of the slowly revolving, gently inclined cylinders down to the burning zone where the slurry is heated to a temperature of 2800 degrees Fahrenheit, 100 degrees higher than the melting point of steel. It requires about three hours for the passage of the slurry through the kilns to produce the burned product called clinker. Huge chains are suspended inside the kilns to keep the slurry from sticking to the sides of the kilns while in motion. The lower end of the kiln is fitted

with a large adjustable hood set on rails to regulate the ingoing hot air, the bulk of which is heated by passing through the clinker coolers. The gas injector to supply the necessary heat for burning the clinker is inserted through this hood. Small doors are fitted into the hood in order that the operator of the kilns may observe the type of flame produced in the kiln and see the clinker. It is necessary for the burner to wear specially prepared glasses to enable him to look directly into the roaring flame. A shot-gun is mounted on a frame and wheeled to the lower end of the kiln and is fired up the side of the kiln to dislodge the clinker from the sides of the kiln without ceasing operations of the kilns. If coal is used as fuel auxiliary equipment is necessary to prepare the coal for consumption by drying and grinding. Crude oil may also be used as fuel to heat the kilns.

Cooling and Storing

From the lower end of the kilns, the clinker, a white hot material, so hard that it will scratch glass, flows into bucket elevators, which in turn feed into coolers which, in general appearance, resemble the kilns themselves. The clinker as it comes from the kilns is in a fairly stable condition and can be stored for months in the open, if necessary, without appreciable deterioration. The rotary coolers are 8 feet in diameter and approximately 70 long and are mounted on an incline. Clinker discharged from the coolers has a temperature of 120 to 130 degrees Fahrenheit. The cooled clinker is placed on a gravity operated automatic scale and divided into accurately weighted batches. The cooled clinker is transported to adjacent storage silos. Located adjacent to the clinker mills will be found gypsum storage silos. Gypsum is used in cement as a retarder to control the setting time of the finished product. Approximately 3 per cent of gypsum is added to the clinker in the process of grinding the clinker into a finished product.

Clinker Grinding

The finished grinding of the clinker is done in Unidan mills, each mill having a separate gypsum and clinker bin. The Unidan mills are revolving steel cylinders, 7 feet in diameter and 40 feet long, lined with hardened steel plates. Each mill is charged with 87,000 pounds of steel balls, varying in size from ⅝ inches to 3½

inches in diameter. After thorough grinding in these mills, the cement is finer than ordinary face powder and is ready to be pumped to concrete silo warehouses for storage awaiting packing and loading.

Packing and Loading

Cement is not packed in containers until shipment is to be made. The cement is drawn from the silos as required and is filled into cloth bags, paper sacks or is shipped in bulk. Automatic packing machines are used to fill the bags with the cement. Previous to filling, the sacks, if they have been used before, are carefully cleaned, mended and tied. It is to be noted that the cloth sacks or paper bags are tightly closed before they are filled with cement. Each sack or bag is fitted with a small sleeve or valve inside the bottom of the sack, with the opening at one end well inside the sack, while the other end opens outside the botom corner of the sack. In order to fill the sack with cement the valve or sleeve opening is slipped over the spout of the filling machine, the bag in this position being upside down. A tube from the bottom of the silos leads into the top of the chamber. At the bottom of the chamber is a small weighing machine, which at the predetermined weight of 94 pounds, opens the air valve. To operate the machine for sack filling, the operator fastens the sleeve of the sack around the inlet pipe and closes the chamber door. This operation starts a small electric air pump working, which makes a partial vacuum sufficient to draw the cement from the silo into the sack. As soon as the correct weight of cement has been delivered into the sack, the filled sack drops, opens the air valve, and by breaking the vacuum causes the flow of cement to stop. The filled containers drop down a chute and are conveyed to the railroad cars for shipment. While the foregoing operation is taking place, the operator removes the filled sack from a second chamber, puts a fresh sack on the inlet pipe, and swings the door around to close this chamber. The cycle of operations is repeated as often as required.

Accounting Methods

The organization of a cement manufacturing company does not differ widely from that of any other industry. Inasmuch as the plants are usually located near the source of raw materials, the

operations of the company are not restricted to the production of cement alone, but also may embrace the operations of a townsite, commissary, hotel and many other facilities which are necessary to provide for the health and well-being of the employees. In the following profit and loss statement the operating incomes and costs of the above noted auxiliary operations are included as extraneous income and expenses.

The balance sheet of a cement manufacturing company does not differ sufficiently from the balance sheets of companies engaged in other industries to warrant any extensive special comment. The only peculiarities in the balance sheet of a cement company, generally speaking, will be found in five items: cloth sack inventory, cloth sacks in customers' hands, customers' accounts receivable, contingent liability for cloth sacks outstanding, and excess sack cost. The other assets and liabilities are common to most industries. These above noted peculiarities will be commented upon in a subsequent paragraph under the discussion of cloth sacks.

Departmentalization

For the purpose of establishing units to which the costs of manufacturing may be assigned, one of the most important steps is the proper departmentalization of the plant. In the subsequent description relating to the accounting for and control of the elements of manufacturing costs, these elements are traced to the point of amalgamation in the product. The first step in manufacturing cost accounting is to assemble and allocate by departments or cost centers the items of manufacturing costs, that is, materials, labor and manufacturing or mill overhead. The next step is to charge these costs to the finished product, and the final step is to account for the cost of the finished cement, both with respect to sales and to the inventory on hand at the end of the accounting period. Consequently, the following profit and loss account has been divided into a cost of production statement and a profit and loss account proper. This segregation of the two statements tends to clarify the statements in the minds of those not familiar with the cement industry.

Inasmuch as cement manufacturing is a continuous process industry, the operating accounts have been segregated into cost centers, that is, points at which inventories are a cost determining fac-

tor. The cost centers are Raw Material No. 1, Raw Material No. 2, Clinker and Cement. Inventories at production cost are applied to the cost centers in question. Separate "Cost of Production" statements are prepared in detail with respect to the foregoing noted cost centers. Summary cost of production statements are shown as Exhibit 1, and a profit and loss account as Exhibit 2. One who is accustomed to preparing profit and loss statements will recognize that there are no departures from the accepted practice with respect to the two statements submitted.

The auxiliary accounts incident to the manufacturing operations of a cement plant, such as the operation of a machine shop, electrical shop, carpenter shop, hospital, hotel and clubhouse, have been included under the general caption of "mill overhead." These accounts may be broken down by elements of cost and distributed monthly to the various operations involved. Likewise, the operations of collateral accounts, such as township and commissary operations, have been included under extraneous income and expenses.

Delivery

Due to the heavy weight of the commodity, the finished product of cement is shipped principally by rail in cloth sacks, paper bags and in bulk. Each cloth sack or paper bag of cement weighs 94 pounds and four sacks make one barrel of cement. The price of cement is based upon one barrel and cement is almost always sold by the mill in carload lots, as less than carload shipments are practically prohibited by the excessive freight rates.

Cement is sold on a delivered basis, that is, the price is quoted f.o.b. destination and the price is based upon the type of container specified. A charge of ten cents per cloth sack is made and this amount is included in the invoice to the customer with the understanding that the company agrees to refund the purchaser the ten cents previously paid, for each of such sacks returned to the company in good usable condition. There is no return value for the paper bags and a charge of fifteen cents per barrel for this type of container is made to the customer. There is no extra charge,

EXHIBIT 1.

COST OF PRODUCTION

	Tons or bbl.	*Amount*	*Average per ton or bbl.*
RAW MATERIAL No. 1—ROCK:			
Production (tons)			
Stripping			
Production			
Crushing, receiving and storing			
Total cost of raw material No. 1			
Add, Inventory at beginning of period			
Less, Inventory at end of period			
Less, Used in stone dust operations			
Used in manufacture			
RAW MATERIAL No. 2—SHALE:			
Production (tons)			
Stripping			
Production			
Crushing, receiving and storing			
Total cost of raw material No. 2			
Add, Inventory at beginning of period			
Less, Inventory at end of period			
Used in manufacture			
CLINKER:			
Production (barrels)			
Raw material No. 1—rock			
Raw material No. 2—shale			
Grinding, mixing and storing			
Burning, cooling and storing			
Total cost of clinker			
Add, Inventory at beginning of period			
Less, Inventory at end of period			
Used in manufacture			
CEMENT:			
Production (barrels)			
Cost of clinker			
Clinker grinding			
Mill overhead			
Reserves			
Total cost of cement			
Add, Inventory at beginning of period			
Less, Inventory at end of period			
Less, Cement used			
Bin cost of cement shipped			

EXHIBIT 2

PROFIT AND LOSS ACCOUNT.

	Barrels	*Amount*	*Average per bbl.*
CEMENT SALES:			
Less, Sales deduction:			
Collect freight			
Prepaid freight			
Commercial drayage			
Price correction and allowances			
Packages—cloth			
Packages—paper			
Cash discount allowed			
Total sales deductions			
Net sales			
COST OF SALES:			
Bin cost of cement shipped			
Shipping expense:			
Packing and loading			
City warehouse expense			
Sack handling			
Sack allowances and excess cost			
Total cost of sales			
Gross profit from sales			
Selling expense			
Advertising and promotion expense			
Administrative and general expense			
Net operating income			
Financial income and expense			
Extraneous income and expense			
Net income before federal income tax			
Provision for federal income taxes			
Net income to surplus			

of course, for shipments made in bulk. The low percentage of shipments of cement made in bulk is due to the lack of equipment of customers for unloading cement shipped in bulk.

Excess Sack Costs

The price paid for cloth sacks and paper bags by the mills varies according to market fluctuations in cotton and paper, but the price of the cloth sacks and paper bags invoiced to the customer is fixed by prevailing trade practices. Therefore, there is an element of excess sack cost involved where the purchase price of the new containers exceed the invoice price of the packages. The proper accounting method with respect to the excess sack cost is to charge "Deferred Expense—Excess Sack Cost," with this difference in price, that is, charge the inventory of cloth sacks with ten cents and charge "Deferred Expense—Excess Sack Cost" with the difference between the actual cost of the new cloth sacks and ten cents. In the case of paper bags, the inventory of paper bags would be charged at a price of fifteen cents per barrel or .0375 per bag and the difference between the cost of the paper bags and the inventory price charged to "Deferred Expense—Excess Sack Cost." This account will be charged to operations, based upon the number of new sacks shipped during the month. This can be determined from the monthly sack report prepared by the sack department. Consequently, when all new cloth sacks have been placed into actual service, the deferred excess sack loss would be absorbed in the operations. Conversely, when the price of the new containers is less than the price at which they are invoiced to the customer, there will be a credit in the "Deferred Expense—Excess Sack Cost" account and this credit should be absorbed into the operations as previously stated.

Since cement is sold on a delivered basis, the former practice was for the customer to pay the freight upon arrival of the car, and to deduct the freight from the invoice price when remitting. However, this practice has been changed as it was not always possible to secure the paid freight bill from the customer to support his deduction from the invoice. The amount of the collect freight is now deducted from the invoice by the mill and only the net amount is charged to the customer's account.

Accounting for Sales

In order to clarify the accounting procedure with respect to the application of the customer's invoice to the various accounts involved, the example of a single invoice will be used. The invoice in question is for 100 barrels of cement at a delivered price of $3 per barrel, or a total invoice amount of $300. The price of $3 per barrel includes the collect freight charges and the shipment is to be made in cloth sacks. The invoice will be prepared using the invoice amount of $300 with a deduction of $150 for freight. The customer's account will be charged with $150, the collect freight account will be charged with $150, and the "Packages-Cloth" account will be charged with $40 (which is 400 sacks at ten cents each). The latter two accounts are treated as deductions from gross sales. The cement sales account will be credited with $300 and inventory of packages-cloth account will be credited with $40. In the event the shipment was made prepaid, the customer's account would be charged with the gross amount of the invoice, $300; prepaid freight charged with $150; cloth packages charged with $40 (both the latter items being sales deductions); cement sales credited with $300; prepaid freight credited with $150 and the inventory of cloth packages credited with $40. Of course, the individual invoices will not be posted in the above manner since a recapitulation of the month's invoices will be prepared and the totals only will be posted to the accounts involved. In the case of the total of the customers' accounts, this total will be posted to the general ledger control account and the details will be posted to the individual customer's account in the accounts receivable ledger.

Accounting for Cloth Sacks

When cement is shipped in cloth sacks the sacks remain the property of the cement company and are treated as returnable containers. The purchaser of the cement agrees specifically to return the sacks to the company within a period of ninety days from the date of delivery and the company agrees thereupon to refund to the purchaser the ten cents previously paid for each cloth sack when returned to the company in good usable condition.

To properly account for the handling of the sacks under these practices, it is necessary to open the following accounts: "Cloth

Sack Inventory," "Cloth Sacks in Customers' Hands," "Customers' Accounts Receivable" and "Contingent Liability—Cloth Sacks Outstanding."

Previous comment has been made with respect to the accounting method used in connection with the shipment of cement in cloth sacks in connection with the customers' accounts and the cloth sack inventory. The accounts, cloth sacks in customers' hands and contingent liability—cloth sacks outstanding, are contra accounts and are adjusted monthly in the following manner. To the cloth sacks in customers' hand account is charged 95 per cent of the total cloth sacks shipped during the month and the contra account; contingent liability-cloth sacks outstanding is credited with this amount. The cloth sacks for this purpose are valued at ten cents each, as that is the agreed repurchase or refund price. Correspondingly, the contingent liability—cloth sacks outstanding account is charged, the inventory of cloth sacks in customers' hands credited, with 100 per cent of the cloth sacks returned by the customers. The returned sacks include all cloth sacks returned by the customer even though full credit is not given to the customer's account due to certain of the returned sacks not being in a usable or serviceable condition. The net effect of the above monthly transactions is to record the contingent liability for cloth sacks outstanding in the hands of customers. The estimated five per cent of cloth sacks shipped to customers which will not be returned is based on past experience, and this percentage may be changed from time to time in the light of the company's experience.

A separate sack register is maintained for the purpose of recording the credits arising from the returned cloth sacks and the payments therefor. Credits resulting from returned sacks are not credited to the customer's account in the usual case, but are paid promptly, that is, as soon as the returned sacks are checked and inspected at the mill. The returned sacks are usually returned in bundles of fifty each and the mill places in each car of cement shipped in cloth packages, a sufficient number of returnable labels or shipping tags for the customer's use in returning the empty sacks. The transportation charges are paid by the mill.

The usual trade terms covering sales are 10 cents per barrel cash discount if the invoice is paid in full within fifteen days from the shipping date. Some cement plants do not allow the cash dis-

count if any part of the customer's account is past due, and in these cases, credits for the returned sacks are not paid for but are credited to the customer's account.

Depletion

Cement manufacturing is a natural resource industry with respect to the raw materials used. In common with lumber, mining, oil and gas, and other industries exploiting natural resources, it is necessary for the company to deplete its natural resources each year as they are used. This is done by a depletion charge based upon the estimated quantity of the raw materials contained in the quarry and the quantity used during a given period.

Depreciation

Depreciation is without doubt one of the most important elements of overhead expense. There are several methods of accruing depreciation with respect to cement manufacturing plants, among them being the straight-line method and the unit-of-production method. The general practice in the cement industry has been to determine the amount of depreciation to be provided during the year based upon depreciation rates applicable to various depreciable property, and to accrue one-twelfth of that amount each month. In months when production is low, this method would materially increase the production costs to such an extent that unit costs would become meaningless for monthly comparative purposes. Therefore, the unit-of-production method should be used. The amount of depreciation to be provided should be ascertained by taking the average estimated life of the various depreciable properties and by making an estimate of the number of barrels of production for the period, then dividing the estimated production into the amount to be provided, to arrive at the amount to be set up per unit of product.

Valuation of Inventories

Inventories of raw materials, clinker and finished cement are usually valued in accordance with the data obtained from the company's cost records and are valued at a "running average" cost. For example, the cement inventory account begins with the in-

ventory of cement at the end of the previous month, and this account is debited with the cement produced during the month, showing both the number of barrels of cement produced and the cost of such production arrived at from the cost of the clinker produced. Then, in order to determine the cost of sales and the cost of cement used in plant operations and construction, the "running average" cost is applied the number of barrels of cement shipped and used during the month. The amounts so determined are debited to the "bin cost of cement shipped and used."

In the case of the inventory being valued at the first-in, first-out method, the closing inventory should be valued at the average cost per barrel of the most recently manufactured stock. In the event that the closing inventory is more than the production for the current month, the excess of the closing inventory over the current production should be valued at the opening inventory value.

Ordinarily, a physical measurement of the inventory of finished cement can be made if the finished product is stored in silo type warehouses. This can be done by dropping a steel tape from the top of the silo to the top of the cement stored in the silo. A very accurate inventory can be determined from the tables indicating the strapped capacity of each silo.